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CRYSTALLINE RUBBER

Crude and refined rubber is known to consist principally of hydrocarbons. These hydrocarbons are mixed with smaller quantities of various impurities which can be removed only by a series of long and tedious operations. The highly purified rubber resulting from these operations is a clear, colorless, transparent, elastic solid, as clear and colorless, in fact, as the best plate glass. The problem of ascertaining the composition of this highly purified rubber has heretofore been exceedingly difficult because of the fact that two of the most useful processes ordinarily employed by the chemist—namely, crystallization and distillation—could not be applied to the material. A process has recently been developed at the bureau by which this pure rubber can be repeatedly crystallized, thus opening the possibility of successfully fractionating it into its constituent hydrocarbons and eventually of determining the formulas of their molecules. The crystalline rubber obtained by this process, as seen under the microscope, consists of small transparent plates. As the crystallization process continues, these plates agglomerate into larger and larger clusters. The crystallization process is carried out by cooling a dilute solution of the highly purified rubber dissolved in ether to a temperature of about -80°C .

The bureau has also succeeded in distilling the purified rubber without decomposition, by heating it in a high vacuum to the temperature of boiling water. This distilled rubber possesses all of the common characteristics of ordinary rubber, but the rate of distillation is not sufficiently great to make this process of much practical value for purifying the rubber in any quantity. It can, however, be used for obtaining small samples of distilled rubber.

Once having fractionated rubber into its constituent hydrocarbons and determined the formulas of their molecules, the possibility of successfully synthesizing these hydrocarbons is increased at least to the extent that one knows exactly the result to be strived for. Furthermore, there is always the interesting possibility that the pure hydrocarbons may have new and useful properties.

DETERMINATION OF THE EMPIRICAL FORMULA OF A HYDROCARBON

The precision aspects of the problem of determining the molecular weight and hydrogen content of a hydrocarbon and of combining the results so as to obtain the empirical formula, are considered in a paper in the Bureau of Standards Journal of Research for October. In certain cases the formula can be deduced from the molecular weight alone, in others from the combustion analysis alone. Where both are required the ac-

curacy necessary in one or both is, in many cases, adjustable within rather wide limits and is determinable in any case. A definite laboratory procedure is outlined for obtaining the desired result with the minimum of effort and inconvenience. By following this procedure it should be possible to determine the empirical formula of any pure hydrocarbon containing not more than 100 carbon atoms. A determination of the bromine-addition number may, in some instances, be substituted for the molecular weight determination or for the combustion analysis, or may be utilized to decrease the accuracy which would otherwise be required in either or both of these determinations. The requirements necessary for the determination of a reliable "average formula" of a mixture of hydrocarbons are formulated. The influence of impurities and of polymerization is discussed.

DETERMINATION OF CARBON IN HIGH-SULPHUR STEELS BY DIRECT COMBUSTION

A knowledge of the correct carbon content of steel is necessary to manufacturers, consumers, and to all those connected with the steel industry. Perhaps no other element is determined as frequently in steel. The rapid and accurate determination of carbon is therefore a very important problem. It has been noted that the method used for the determination of carbon in ordinary steels fails when it is applied to high-sulphur steels. This problem has been investigated at the bureau, and the method modified so that it can be used for the accurate determination of carbon in steels containing any amount of sulphur. A complete report will appear in the Bureau of Standards Journal of Research for October.

IMPORTANCE OF PARTICLE SIZE IN SAMPLES OF CERTAIN METALLURGICAL MATERIALS

It is a difficult matter to sample certain metallurgical materials so that their average chemical composition can be determined correctly. Such difficulties arise if the original material is not uniform in composition or if it contains brittle components. The effect of the former is well recognized and can be overcome by sampling the material in a sufficient number of places. The effect of the latter is to cause a concentration of the brittle constituents in the finer portions of the sample, and is often unsuspected. Typical examples are given

and corrective measures are suggested in the report which will be published in the October number of the Bureau of Standards Journal of Research.

ANALYSIS OF PHOTOGRAPHIC EMULSIONS

Investigations of photographic sensitivity by independent methods have all led to the conclusion that in highly sensitive emulsions the grains of silver halide contain traces of some foreign material acting as "sensitivity nuclei"; without specifying the means of their action, these decrease the exposure to light necessary to make the silver halide developable. Since sensitivity may be increased by digesting (ripening) the silver halide with the gelatin of the emulsion at an elevated temperature, it was reasonable to assume that the sensitivity nuclei are metallic silver produced by reduction; this is supported by the marked decrease in sensitivity of ripened emulsions on treatment with oxidizing agents. The Eastman kodak laboratories have also definitely established that photographically active gelatins contain sulphur compounds which react with silver bromide, under the conditions of emulsion making, to form silver sulphide; and that this leads to an increase in sensitivity similar to that produced by digestion. Chemical analysis of the sensitivity nuclei would be highly desirable, but the optimum amount of sensitizing sulphur compounds is so small that this appeared almost impossible.

Recently, however, two laboratories have independently reported the presence in unexposed photographic emulsions of silver, or a compound of silver other than a halide. Weigert and Lühr¹ fixed finished plates in slightly alkaline thio-sulphate solutions, washed thoroughly, repeated the thio-sulphate bath and washing, then dissolved the silver remaining in the emulsion film by nitric acid, and analyzed by potentiometric titration. From 0.01 to 0.04 per cent of the total silver remained in the emulsion after this treatment. This is an unexpectedly large amount, since direct photochemical decomposition of silver halides to this extent may produce visible darkening. Experimental emulsions gave results of the same order, with the amount of silver increasing on digestion as would be predicted. If the silver found by this method is originally present in the emul-

¹ Weigert and Lühr, *Naturwissenschaften*, **15**, p. 788; 1927; *Zeit. f. Elektrochemie*, **34**, pp. 605-610; 1928; *Zeit. f. wiss. Phot.*, **27**, pp. 293-303, 312-337; 1930.

sion it must be metallic silver, or silver sulphide. Weigert considers it is the true photosensitive component of the emulsion, rather than the silver halide.

Schmidt and Pretschner² digested large quantities of very thoroughly washed (uncoated) emulsion with nitric acid, and made a gravimetric analysis for silver in the solution with elaborate precautions. They report that in fast emulsions, containing about 97 per cent AgBr and 3 per cent AgI, the silver is 0.08 per cent in excess of the halogens; in silver chloride emulsions the excess may be as much as 0.6 per cent. The excess silver found by their method varies directly with the solubility of the silver halide and is independent of the speed of the emulsion. It, therefore, seems impossible that there can be a direct connection between these determinations and the sensitivity nuclei. Schmidt and Pretschner further found that, on centrifuging the silver halide grains out of an emulsion, most of the excess silver was found in the gelatin. They conclude that in silver chloride emulsions a silver-gelatin compound may be present, but that this compound is decomposed by bromide or iodide and can not exist in silver bromide emulsions. Silver in such a compound would be determined by their method, but not by that of Weigert and Lühr.

In studying the effects of excess silver or halide in photographic emulsions at the National Bureau of Standards some of the work of the German investigators has been repeated; potentiometric titration has been substituted for the gravimetric methods used by Schmidt and Pretschner. It is found that the combination of silver ion with gelatin is much stronger than had been expected, and can account for the large values obtained by Schmidt and Pretschner. It is dependent on the hydrogen concentration; in an emulsion ready for coating, the free silver ion concentration rose from 2×10^{-7} N to 7×10^{-8} N when the pH was changed from 7 to 4. On extremely thorough washing, both of fast commercial plates with 4 per cent AgI and of experimental emulsions of similar composition, but made so as to contain the minimum of ripening nuclei, the excess silver as determined by nitric acid extraction rose to an equilibrium value of 0.3 to 0.4 per cent; the immediate change

in photographic properties was very small. This excess can not be metallic silver, for at least 90 per cent of it can be extracted by N/100 acetic acid; similarly, if the emulsion is stripped with hot water and acidified to a pH less than 4.7, there is a sudden rise in silver ion concentration, and electrometric titration gives a value almost identical with nitric acid extraction. In an emulsion containing the normal small amounts of soluble bromide, the silver ion concentration is so reduced that the formation of silver gelatinate is inappreciable; but on prolonged washing, with the bromide ion concentration kept at a minimum, the silver ion activity is so increased that relatively large amounts are formed. Data on the equilibrium between silver and hydrogen ions and gelatin will be given in the complete report of this work in the Bureau of Standards Journal of Research.

Results with the thiosulphate method of analysis were in general agreement with those reported by Weigert and Lühr, although tests with known suspensions of colloidal silver in gelatin indicate that there is probably an appreciable loss of silver oxidized by dissolved oxygen in the solutions. The analytical agreement does not in itself confirm the views of Weigert as to the photographic importance of this silver. It is well known that considerable amounts of colloidal silver may be introduced into an emulsion under certain conditions with very little photographic effect, and it seems reasonable that most of the silver formed during the preparation of the emulsion should be dispersed through the gelatin and not associated with the silver halide grains as sensitivity nuclei. The analytical determination of the nuclei, if they can be isolated, will still be a matter of very great difficulty.

COPPER ELECTROTYPING

During the past 15 years researches on electrotyping have been conducted at the National Bureau of Standards and other institutions. A new circular, No. 387 (superseding Circular No. 52, 2d ed.), has now been published which brings together in simple readable form the results of such researches. It includes simple definitions of terms and units employed in electrodeposition and the condition for the satisfactory operation and control of copper electrotyping solutions. Conversion tables for the ordinary and scientific units are included. Tables are also given to show the weight and thickness of copper deposited at given current densities for specified periods.

² Schmidt and Pretschner, *Zeit. f. wiss. Phot.*, **25**, pp. 293-307, 354-362; 1928: **26**, pp. 86-95, 259-274, 375-380; 1928-29: **27**, pp. 36-47, 173-177; 1929: **28**, pp. 30-34, 25-40, 111-117; 1930.

The circular is written primarily for the benefit of practical electrotypers, in order to enable them to make use of the results of scientific studies in this field.

Copies of this circular are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each.

VALUE OF ADDITION AGENTS IN COPPER ELECTROTYPING SOLUTIONS

In the manufacture of copper electrotypes for the printing industry, various addition agents are used in the solutions in order to permit more rapid deposition and to produce harder deposits of copper. A recent investigation by the bureau has shown that of the substances that may be used for this purpose, phenol (carbolic acid) is most effective. When a small amount of this substance (in the form of a compound with sulphuric acid) is added to the solutions, deposits can be produced under favorable conditions in about one-fourth the time commonly used in electrotyping. Such deposits are also harder than those obtained without any addition agents, and, therefore, will give better service on the printing presses.

This work will be described in detail in the October number of the Bureau of Standards Journal of Research.

THE MEASUREMENT OF SOUND ABSORPTION

The Bureau of Standards Journal of Research for October will contain an article giving a description of the different methods used for the measurement of sound absorption coefficients.

The theory is given rather briefly, and the requirements are described which must be met if satisfactory measurements of the sound absorption coefficients are to be obtained.

A description and sketch of the new reverberation room are given. The requirements of a satisfactory source of sound are discussed and graphs are given showing that the loud speaker, which was used as the source of sound, met these requirements.

The method of calibrating the room and determining the sound absorption coefficients by using the ear as a measuring instrument is also described. As the observer's judgment modifies these measurements to some extent it is necessary to take a large number of measurements. Several thousand measurements were required to calibrate the room and about 1,000 measurements more were necessary to determine the sound absorption coefficients of a sample for six frequencies.

This required too much time and work, and attempts were, therefore, made to change to an instrumental method of some kind which would be more accurate and also shorten the time required.

The first attempt was to use an oscillograph for obtaining a photograph of the decay of the sound. It was possible to compute the absorption from the information on the photograph, but the amount of work involved proved to be excessive.

The method in use at the present time is a purely instrumental one. The rate of decay is determined by the use of a timer and a vacuum tube voltmeter. The results obtained in this way agree well with those obtained by the reverberation method.

SOUND ABSORPTION COEFFICIENTS

The following figures have recently been obtained at the National Bureau of Standards for the sound absorption coefficients of a number of materials now on the market as acoustic correctives. The results have been obtained by the reverberation method.

It is not necessarily the case that the materials of highest coefficients are the most advantageous. Where there is room to apply the requisite quantity a material of low coefficient will give the same result.

Material	Absorption coefficients for frequencies—				
	128	256	512	1,024	2,048
Lime plaster panels (Ohio Finishing Lime Association).....	0.17	0.23	0.28	0.36	0.64
Acoustex, painted:.....					
Type 60, 1-inch thick.....			.37	.56	
Type 65, 1-inch thick.....			.47	.73	
Laminated acoustic tile (Thos. Moulding Brick Co.):.....					
1-inch thick.....			.53	.62	
1½-inch thick.....			.60	.70	

NEW ZEALAND FLAX AS A PAPER-MAKING MATERIAL

An investigation to determine the paper-making value of New Zealand flax has been in progress. Samples of the flax—unscutched, scutched, and tow—which at present is used commercially only for cordage, were submitted to the bureau with request for information relative to the suitability of the material for the production of paper.

Paper-making tests have been made on both laboratory and semicommercial

scales. The test procedure followed was essentially the same as that generally observed in the production of paper.

Cooks were made using caustic soda, caustic soda and sodium sulphide combined, and sodium sulphite and caustic soda separately, as the reducing agents.

When the flax was cooked by the caustic-soda process with comparatively small amounts of caustic (10 per cent) the pulp was suitable for good bag or wrapping paper; with larger amounts of caustic (25 per cent) it could be bleached with about 14 to 16 per cent of bleach and was then satisfactory to use in admixture with other pulps in making fine papers.

The yield of air-dried unbleached pulp from the 25 per cent caustic cook of unscutched New Zealand flax was 57.2 per cent, based on the bone-dry weight of the flax, in the semicommercial tests, and 57.7 per cent in the laboratory test. The results of the laboratory and semicommercial tests, therefore, checked very closely as to yield when similar cooking conditions and amounts of

chemical were employed. When 10 per cent of caustic soda was used the yield of unbleached pulp was 77.4 per cent. This pulp was suited only for wrapping paper, however, whereas that from the 25 per cent caustic soda cook could be bleached and the resultant pulp was satisfactory for use in fine paper.

Unscutched flax cooked with 15 per cent of caustic soda and 10 per cent of sodium sulphide combined gave a yield of 62.2 per cent. The pulp obtained was satisfactory for use only in wrapping paper.

The pulp from the 2-stage cooks—the first with 25 per cent of sodium sulphite, the second with 10 per cent of caustic soda—seemed to give the most satisfactory results. The yields of unbleached pulp were: 37.2 per cent for unscutched flax, 48.5 per cent for the scutched flax when not dusted, 60 to 65 per cent for the dusted scutched flax, and 56.9 per cent for the dusted tow.

Some of the test results on the machine-made papers are given in the following table:

	Weight 25 by 40, 500 sheets	Bursting strength	Folding endurance		Tensile strength		Tearing strength	
			Ma- chine direc- tion	Cross direc- tion	Ma- chine direc- tion	Cross direc- tion	Ma- chine direc- tion	Cross direc- tion
Flax, unscutched, bleached; 25 per cent caustic soda cook.....	Pounds 56.8	Lbs./in. ² 37.7	Double folds 341	Double folds 487	kg 9.1	kg 6.2	g 64.4	g 63.4
Flax, unscutched, unbleached; 25 per cent caustic soda cook.....	58.9	61.6	4,060	2,824	11.9	7.9	106.6	98.4
Flax, unscutched, unbleached; 10 per cent caustic soda cook.....	57.5	52.5	1,510	2,250	10.8	6.5	114.0	95.2
Flax, scutched, bleached; 2-stage cook, 25 per cent Na ₂ SO ₃ and 10 per cent NaOH.....	56.1	40.1	670	1,305	9.2	6.0	63.8	67.6
Flax, tow, bleached; 25 per cent caustic soda cook.....	55.1	42.6	700	735	9.3	5.8	71.2	78.0

The results of the tests thus far seem to indicate that if the flax can be properly cleaned, freed from dead fibrous materials, and the woody sections eliminated from the scutched material, a fair grade of pulp suitable for use with other pulps in making a fine paper can be obtained.

As soon as the investigation is completed a report of the work will be prepared for publication.

NONSLIP RUGS

An interesting application of the inclined plane test for slipperiness or coefficient of friction of fabrics, to be described in a forthcoming issue of the

Bureau of Standards Journal of Research, was made during the month. Two samples of rugs, one of which had been treated with a commercial preparation to make it resistant to slipping, and a commercial rug underlay were tested. The results follow:

Condition of rug	Angle of repose	Coefficient of friction
Untreated.....	18°	0.325
Treated.....	32°	.645
Rug underlay.....	54.5°	1.40

FIRE TESTS OF WELDED STEEL FLOOR CONSTRUCTION

A research project has been undertaken in cooperation with the American Institute of Steel Construction to determine the fire resistance of a new type of welded steel floor construction. The structural elements of this type of floor consists of rolled steel beams, generally 3, 4, or 5 inches in depth, spanning between girders, the upper flanges of the beams being welded to steel plates generally one-fourth inch thick. The beams are spaced 2 feet apart, the steel plate serving the purpose of the usual floor slab.

Fire exposure will be applied to the floors from below in most tests but in six tests fire exposure from above will be applied by burning combustible materials, such as wood and paper in amounts from 10 to 40 lbs./ft.² of floor area. Various degrees of protection will be given the upper surface of the steel plate floor for these tests, from the bare plate to protections of 2-inch thickness of light-weight concrete.

The fire exposure from below will be obtained with a gas furnace using 48 horizontal venturi-tube induction burners. The protection applied to the beams will vary for the different tests from a three-fourth-inch thickness of plaster on metal lath to 2-inch gypsum slabs hung from the lower beam flanges to form a suspended ceiling. Three tests in which a hose stream will be applied to the heated floor after a period of fire exposure will also be included.

The floors will be supported during test within a heavy steel restraining frame, and superimposed loads of 45 to 160 lbs./ft.² will be maintained constant during the fire tests. For some tests the floor connections with the restraining frame will be designed to give full restraint to the construction during test, and for others the ends of the beams and plates will be freely supported with opportunity for expansion. The test floors will be 18 feet long and 13½ feet wide. The beams will span the full 18-foot length of the floor except in five tests where the beams will be supported on a girder at an intermediate point to introduce the details of fireproofing required for the girder.

A STUDY OF WEATHER ACTION ON MARBLE

A large block of large crystal calcite marble recently obtained from near the top of a chimney on the U. S. Patent Office Building, where it had been exposed to severe weather conditions for

about 70 years, afforded a good opportunity for studying how the weather attacks this building material. The dimension between the face exposed on the outside of the chimney and the inner face was 8 inches. The outer face was freely exposed to normal weathering conditions while the inner face was protected to a small degree by the chimney walls, but exposed to any chemical actions resulting from the collection of soot.

This block was sliced into slabs parallel to the weather faces and tested for strength and absorption. Strength determinations showed that the marble at the outside face had lost about 70 per cent of its original strength and at the inside face about 60 per cent. The strength increased uniformly toward the middle to about 55 per cent of the original. Absorption results indicated that the porosity of the material had increased to nearly three times the original at the weathered faces, but only about 40 per cent at the middle.

Specimens cut from the weathered faces were subjected to freezing and thawing tests under the most severe conditions which could be devised. Although these have undergone more than 700 cycles of this test, no appreciable amount of decay has been noted. Many well-known building materials would be totally disintegrated by such a test, but the indications are that frost has very little effect on marble.

Appearance of the exposed surface, as well as strength and absorption tests, show that this marble has been altered from its original state. Many parts of the marble in this building show crystals entirely loosened and the surface crumbling away.

It has long been recognized that the acid condition of the rain water causes an appreciable amount of surface solution on carbonate rocks, but it seems to have been assumed that the acid is neutralized before it penetrates the pores. This study affords considerable evidence that acid action takes place within the pores as well as at the surface, resulting in a gradual enlargement of the pores until the crystals are entirely loosened.

X-RAY STUDY OF CONSTITUTION OF PORTLAND CEMENT

The X-ray diffraction method has been applied to a study of the constitution of Portland cement clinker.

It has been found that $2\text{CaO} \cdot \text{SiO}_2$ and CaO combine to form $3\text{CaO} \cdot \text{SiO}_2$ and not a solid solution of $2\text{CaO} \cdot \text{SiO}_2 + \text{CaO}$; that $8\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$ does not exist in

Poland cement systems; that solid solutions are not formed between the aluminates and silicates of cement systems; and that free CaO is not present generally in commercial cement in amounts as great as 2.5 per cent.

The limiting amounts were determined of each cement compound that could be identified by X-ray means as employed in this study. Twenty-eight commercial cement clinkers were subjected to X-ray examination, and $3\text{CaO} \cdot \text{SiO}_2$ and $62\text{CaO} \cdot \text{SiO}_2$ were identified in each. $3\text{CaO} \cdot \text{Al}_2\text{O}_3$, $4\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{Fe}_2\text{O}_3$ and MgO were found in the samples which contained those compounds, by calculation, in amounts great enough to permit of identification.

A full report will be made in the October number of the Bureau of Standards Journal of Research.

FURTHER STUDIES OF THE "MOISTURE EXPANSION" OF WHITE WARE

An endeavor is being made to determine the nature of the reaction manifested by an increase in volume when water permeable ceramic bodies are subjected to moisture. The magnitude of these changes, and their relation to body composition and degree of water permeability, has been presented in Technical News Bulletins Nos. 146, 153, 156, and 160 (June, 1929, and January, April, and August, 1930). The minimum temperature at which the moisture causing this expansion can be removed from the body, and the accompanying contraction completed, should indicate whether or not actual hydration has taken place. This minimum temperature was determined approximately by holding previously autoclaved water permeable specimens at specific temperatures and observing the shrinkage by means of the interferometer, the specimens being weighed before and after these heat treatments to determine the change in weight. Specimens of three commercial bodies were tested. Although the specimens were dried to constant weight at 110°C . before the autoclave treatment, the loss in weight when held at temperatures of 120° and higher exceeded the gain in the autoclave. The gain in the autoclave varied from about 10 to 15 per cent, while the weights after the heat treatments were from 0.0 to 0.7 per cent less than the original weights after drying at 100°C . The specimens continued to lose weight up to approximately 250° . That this temperature approximates the minimum required to counteract moisture expansion is also indicated by the contraction in volume. Specimens held

at approximately 120° , 180° , and 200° until contraction practically ceased showed further contraction at higher temperatures, but when held at 240° to 256° until contraction ceased showed no further evidence of contraction, due to elimination of moisture, at higher temperatures. The greatest contraction noted, due to elimination of moisture, was obtained by holding a specimen at 240° to 250°C . for 5 hours and equalled 0.075 per cent. That the moisture causing expansion can not be eliminated at temperatures below approximately 250°C . indicates that it is in more intimate contact than so-called pore water and hygroscopic moisture. Just what the nature of the reaction or combination between the moisture and the specimens is has not been demonstrated.

BUREAU OPENS TWO NEW BRANCHES IN ALABAMA

Arrangements have been completed through the Alabama industrial development board for the opening of two stations of the bureau in Alabama. The one at Alabama Polytechnic Institute was started on August 15, the one at the University of Alabama will start on September 2.

The Alabama Polytechnic Institute and the bureau are about to begin a co-operative research on starch at the newly opened chemical laboratories of the institute at Auburn, Ala. This investigation will have to do primarily with the starches found in crops in the South.

A study will be made of the uses of starch in the manufacture of textiles, and the properties required in starch for each use. Further, it is planned to determine whether starch from one source is superior to that from another for given purposes, and if specific starches may be modified so as to better adapt them for particular uses.

A fundamental study of the chemical reactions involved in the sulphate pulping process is also being initiated by the bureau in cooperation with the University of Alabama. This process is used for the production of the southern kraft paper which has attained large proportions in recent years. More definite information on the complicated chemical reactions of this process is sought to extend its field of usefulness. Such information should be beneficial in several respects, such as in the production of by-products, in the production of fibers having a greater variety of use, in the use of more fibrous materials, and in more complete recovery of the pulping chemicals.

CLASSIFICATION OF RADIO SUBJECTS; AN EXTENSION OF THE DEWEY DECIMAL SYSTEM

A paper entitled "Classification of Radio Subjects; An Extension of the Dewey Decimal System," was published in the August, 1930, issue of the Proceedings of the Institute of Radio Engineers. This is a second edition of a Circular of the Bureau of Standards published in 1923. This revised edition brings the classification up to date and makes a few changes which use has shown to be necessary. The paper gives a systematic scheme of classification of subjects in radio science and engineering for use in classifying references to current radio publications and also for classifying all sorts of other radio material, such as reports, reprints, drawings, books, apparatus, etc.

Since the publication of the first edition in 1923, this subject classification has been used extensively by radio research workers and engineers throughout the world.

The paper will also appear as a forthcoming Circular of the Bureau of Standards.

BUREAU PUBLICATIONS IN AVIATION FIELD

Letter Circular No. 285, Aeronautical Publications by Members of the Staff of the Bureau of Standards, has recently been issued. This pamphlet contains references to the work done in this field at the National Bureau of Standards, whether reported in the bureau's own series of publications or in outside journals. The articles are grouped under the following headings: Aerodynamics; aircraft materials and construction; aeronautic power plants; aircraft instruments; radio aids to air navigation; and miscellaneous.

Copies of Letter Circular No. 285 will be furnished free on request to the National Bureau of Standards.

PROPERTIES OF SOLID CARBON DIOXIDE

A mimeographed pamphlet, Letter Circular No. 286, entitled "Solid Carbon Dioxide," has just been issued. This letter circular gives in a terse way the physical properties of this material with references to sources of information. It contains sections on density, temperature, vapor pressure, latent heat of sublimation, latent of fusion, specific heats of solid and gaseous carbon dioxide at low temperatures, refrigerating effect, and uses, as well as a bibliography of papers

on the manufacture and use of solid carbon dioxide as a refrigerant.

Copies of this letter circular will be sent free on request to the National Bureau of Standards.

OFFICIAL TIME-ZONE MAP OF THE UNITED STATES

A map showing the standard-time zone boundaries for the United States with adjacent parts of Canada and Mexico has just been issued by the National Bureau of Standards. This is the first official map of its kind issued by the Government. The base map was supplied by the U. S. Geological Survey and the time-zone boundary lines placed upon it from information furnished by the Interstate Commerce Commission, the Hydrographic Office of the Navy Department, and the Dominion Observatory of Canada.

It will be useful in determining true and local time for radiobroadcasts; those making long-distance telephone calls will find it of service in keeping appointments; and it will be helpful to those planning trips by auto or rail. The aviator is particularly concerned in connection with transcontinental and other flights. It will be an asset to business, since the closing hours of offices are governed by local zone time and a complete knowledge of the zone boundaries and the territory included between them is desirable. Hotels, service stations, railroads, and places accommodating transients may find it a convenience to their patrons to have such a chart on display for consultation.

This map is printed in light blue on a white background, the location of the cities being indicated in black lettering and the time-zone boundary lines appearing in red. Its dimensions are 20 by 30 inches. Copies of this chart, designated as Bureau of Standards Miscellaneous Publication No. 111, may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each.

CONSTRUCTION ACTIVITY DURING JUNE, 1930

The value of construction contracts awarded in 37 States during June, 1930, as reported by the F. W. Dodge Corporation, amounted to \$600,573,400, an increase of 10 per cent over June, 1929, when contracts let were valued at \$545,891,000.

Contracts awarded for public works and utilities and nonresidential construction for the first six months of 1930 are

slightly larger than the corresponding period of 1929 and substantially larger than the 1925-1929 average. However, residential construction during the first half of this year was only about one-half as great as during the same period of last year. This caused the total value of contracts awarded for the first six months to be 13 per cent less than for the same period of 1929.

NEW AND REVISED PUBLICATIONS ISSUED DURING AUGUST, 1930

Journal of Research¹

Bureau of Standards Journal of Research, Vol. 5, No. 2, August, 1930 (RP. Nos. 194 to 210, inclusive). Obtainable by subscription. (See footnote.)

Research Papers¹

(Reprint from Journal of Research)

- RP183. A comparison of resolving power and sensitivity of photographic plates with varying development; B. H. Carroll and D. Hubbard. Price, 5 cents.
- RP184. Resonance and quenching of the third principal series line of caesium; C. Boeckner. Price, 5 cents.
- RP185. Relationships between Rockwell and Brinell numbers; S. N. Petrenko. Price, 10 cents.
- RP186. Photo-ionization of caesium by line absorption; F. L. Mohler and C. Boeckner. Price, 10 cents.
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Commercial Standards Monthly¹

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Miscellaneous Publications¹

M111. Standard time zones of the United States; and adjacent parts of Canada and Mexico. (Chart, 20 by 30 inches.) Price, 10 cents.

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- Safety in the household. M. G. Lloyd; Safety Engineering (New York, N. Y.), Vol. LX, No. 1, p. 13; July, 1930.
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- Gasoline requirements of commercial aircraft engines. H. K. Cummings; Society of Automotive Engineers' Journal (New York, N. Y.), Vol. XXVII, No. 2, pp. 212-217, 233; August, 1930.
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